Bilateral Hip Prostheses Prostate Cancer Patient with SpaceOAR® hydrogel insertion - A Case Study.

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Introduction

Intensity Modulated Radiation Therapy (IMRT) planning for prostate cancer patients with bilateral hip prostheses require special beam arrangements that do not pass through the devices. While this method avoids the dosimetric complications due to metallic inhomogeneity, it can result in increased dose to rectum and the bladder 1,2. One innovative approach to reduce rectal toxicity is to position a spacer between the rectum and the prostate, effectively pushing the rectum away from the high dose radiation fields 3.

Background & Objectives

• SpaceOAR® hydrogel is a polyethylene glycol-based hydrogel manufactured by Augmenta, used to temporarily position the anterior rectal wall away from the prostate (Figure 1 & 2).
• Through a case study, we describe the advantages of using SpaceOAR® hydrogel for IMRT of prostate cancer with bilateral hip replacements.

Case

• 73 year old male with intermediate risk prostate cancer.
• Gleason 3+3, history of Inflammatory Bowel Disease (IBD).
• Bilateral hip replacements in situ (Figures 3 & 4).
• Dose prescription of 78Gy in 39 fractions at 5 fractions per week to the prostate including 5Gy in 39 fractions to the seminal vesicles.

Methods

• SpaceOAR® hydrogel insertion performed 1 month prior to RT. This was strongly indicated as patients with IBD are at an increased risk of developing radiation proctitis from external beam irradiation 4.
• Co-registered CT and MRI to facilitate accurate delineation of target and organs at risk (OAR) 1.
• 7 field co-planar IMRT plan defined with customised angles to avoid direct beam entry to target volumes through the prosthesis.
• An estimated pre-SpaceOAR® rectal wall contour was created to approximate the pre-spaceOAR® rectal dose. This contour was established by shifting the existing rectal contour anteriorly into the space occupied by the hydrogel.

Results

• Post SpaceOAR® gel insertion, an average space of 1.2cm (total volume of 15cm³) was created between the rectum and the prostate gland.
• The plan exceeded all departmental dose constraints without the use of non-coplanar field arrangements, often required for IMRT prostate planning involving bilateral hip replacements 1,4.
• DVH comparison of estimated pre-SpaceOAR® rectal wall and rectal wall contours showed a decrease in dose absorbed in the presence of hydrogel. (Figure 5)

Conclusions

• In the presence of hydrogel, this patient was able to receive a plan with conformity not otherwise expected in the literature due to the avoidance of the prostheses.
• Minimising irradiated rectal volume is critical in patients affected by IBD. Spacing the rectum from the prostate reduces rectal dose and therefore a lower risk of rectal toxicity can be expected.
• A limitation of this study was that no pre-SpaceOAR® insertion CT and MRI scans were available to accurately determine the amount of reduction in dose received by the rectum.
• Therefore, the estimated rectal position was used to determine the potential reduction in dose to the rectum as a result of the hydrogel for this patient.

Future direction

• Epworth Radiation Oncology has secured a research grant in expanding the number of cases for all intact prostate cancer patients receiving IMRT.
• The research proposed is a prospective Phase II Dose Escalation trial aimed at assessing: Separation gained through the insertion of SpaceOAR®. Dose escalation around the current 78Gy without compromising rectal NTCP (Normal Tissue Complication Probability).

References

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Figure 1 (left). Separation created between anterior rectal wall and prostate using SpaceOAR® technology. (Image used with permission from Augmenta, Waltham, MA, USA)

Figure 2 (above). Setup, Delivery and Equipment used for hydrogel insertion. Image used with permission from Augmenta, Waltham, MA, USA

Figure 3. Planning CT (left) affected by artefact from bilateral hip prostheses. Subsequent MRI (right) displaying well-defined with tissue resolution including SpaceOAR® hydrogel.

Figure 4. Transverse view displaying field arrangements and artefact correction.

Table 1. Absorbed dose by rectal wall within constraints as defined by Epworth Radiation Oncology.

<table>
<thead>
<tr>
<th>Rectal Wall</th>
<th>V30Gy &lt;65%</th>
<th>V30Gy &lt;50%</th>
<th>V50Gy &lt;30%</th>
<th>V70Gy &lt;25%</th>
<th>V70Gy &lt;0%</th>
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</thead>
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<tr>
<td>Normal Wall</td>
<td>59</td>
<td>30</td>
<td>17</td>
<td>7</td>
<td>0</td>
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</tbody>
</table>

Figure 5. DVH demonstrated dose absorbed by rectal wall and estimated pre-SpaceOAR® rectal wall.

Figure 6. Resulting Dose Distributions at isocentre of beads: 300Gy (Top), 500Gy (Centre), 700Gy (Bottom).